

WHAT IS CLAIMED IS:

1. A radially expandable artificial valve prosthesis for deployment in a bodily passage, comprising:
 - a valve structure adapted for restricting fluid flow therethrough;
 - 5 a support structure attached to the valve structure, wherein at least a portion of the support structure is adapted to expand upon deployment to create an artificial sinus in the bodily passage adjacent to the valve structure; and
 - 10 wherein the artificial sinus is configured to create retrograde flow vortices sufficient to substantially prevent stagnation of fluid therein.
2. The radially expandable artificial valve prosthesis of claim 1, wherein the support structure is expandable to a particular diameter upon deployment, and wherein the valve prosthesis is configured such that the artificial sinus comprises a portion of the bodily passage that is substantially unsupported 15 by the support structure such that the artificial sinus is adapted to assume a diameter that is larger than the deployment diameter of the adjacent support structure.
3. The radially expandable artificial valve prosthesis of claim 2, wherein the sinus has a proximal and distal end such that support structure include a 20 first portion disposed adjacent to the proximal end of the sinus and an interconnecting second portion adjacent to the distal end of the sinus.
4. The radially expandable artificial valve prosthesis of claim 3, wherein the first and second portions of the support structure are interconnected by a pair of oppositely placed struts.

5. The radially expandable artificial valve prosthesis of claim 4, wherein in the valve structure is connected at least in part to the oppositely placed struts.
- 5 6. The radially expandable artificial valve prosthesis of claim 1, wherein the support structure comprises a first end and a second end, wherein the valve structure is located about the first end and the first end of support structure has an enlarged diameter that is configured to create the artificial sinus about the valve structure.
- 10 7. The radially expandable artificial valve prosthesis of claim 1, wherein the expandable support structure includes an intermediate portion, a proximal portion, and a distal portion; wherein the intermediate portion has a diameter that is larger than the diameter of the distal and proximal portions such that an artificial sinus is created thereabout.
- 15 8. The radially expandable artificial valve prosthesis of claim 7, wherein the intermediate, proximal, and distal portion comprise interconnected segments.
- 20 9. The radially expandable artificial valve prosthesis of claim 8, wherein the intermediate portion comprises a first and a second radially expandable anchoring portion that each include a first end, a second end and at least one constraining mechanism configured with the first end and the second end of the first and second radially expandable anchoring portion being of different diameters such that the first and second radially expandable anchoring portions collectively form the artificial sinus.
- 25 10. The radially expandable artificial valve prosthesis of claim 7, wherein the intermediate portion comprises the artificial sinus that forms a

expanded portion extending outward from adjacent portions of the collapsible support structure.

11. The radially expandable artificial valve prosthesis of claim 10, wherein the support structure comprises a superelastic material.

5 12. The radially expandable artificial valve prosthesis of claim 11, wherein the superelastic material comprises nitinol.

13. A radially expandable artificial valve prosthesis for deployment in a bodily passage, comprising:

10 a valve structure, including a plurality of leaflets adapted to restrict fluid flow therethrough;

a support structure attached to the valve structure;

wherein each of the plurality of leaflets is oriented closely with the longitudinal axis of the bodily passage throughout the majority of the lengths thereof with the distal portions thereof extending circumferentially 15 and distally to form a seal with at least one of the walls of the bodily passage and the support structure; and

wherein the configuration of the leaflets creates pockets between the leaflets and the walls of the bodily passage of sufficient size and shape to facilitate the creation of retrograde flow patterns capable of reducing 20 stagnation of fluid therein.

14. A radially expandable artificial valve prosthesis for deployment in a bodily passage, comprising:

a valve structure comprising leaflets adapted to restrict fluid flow therethrough;

25 a support structure attached to the valve structure;

a covering of material extending over the support structure;

wherein the support structure includes a first section having a first diameter and a second section attached below the first section having a second diameter substantially smaller than the first diameter such that retrograde flow increases in velocity as it passes through the second
5 section; and

wherein the valve structure is located within the second section such that pockets are formed between the valves structure and walls of the bodily passage, the pockets configured to be continually flushed by retrograde flow from above.

10 15. A radially expandable artificial valve prosthesis for deployment in a bodily passage, comprising:

a valve structure, including a plurality of leaflets adapted to restrict fluid flow therethrough;

15 a support structure comprising a series of proximal bends comprising commissural points for the attachment of the plurality of leaflets and adjacent distal bends located therebetween, wherein the proximal bends generally define a first angle and the distal bends generally define a second, larger angle such that the leaflets maintain an orientation that is substantially parallel with the bodily passage as they extend
20 proximally from the proximal bends before curving outward to engage at least one of the support structure and the vessel wall; and

25 wherein the orientation of the leaflets is configured such that a pocket is created adjacent the proximal surfaces thereof which is of sufficient size and shape such that fluid flowing in the retrograde direction is capable of achieving flow patterns that reduce stagnation of fluid therein.

16. A radially expandable artificial valve prosthesis for deployment in a bodily passage, comprising:

a valve structure comprising one or more leaflets adapted to restrict fluid flow therethrough, the leaflets includes an inner edge;

a support structure configured to carry the valve structure;

wherein the support structure includes one or more longitudinal

5 attachment struts along which the at least a portion leaflets are attached, the longitudinal attachment struts oriented substantially longitudinally with respect to the device such that the leaflet are coaptable with one another over a substantial portion of their length when the device is implanted within the body passage.

10 17. The radially expandable artificial valve prosthesis of claims 16, wherein the support structure comprises a first and a second substantially parallel longitudinal attachment struts and a pair of opposing leaflets attached theralong.

15 18. The radially expandable artificial valve prosthesis of claim 16, wherein the valve includes a pair of commissural points spanning an orifice created between the leaflets, and wherein the support structure includes a first and a second longitudinal attachment strut extending distally from each commissural point, the first and second longitudinal attachment struts defining a first angle therebetween that is less than 30°.

20 19. The radially expandable artificial valve prosthesis of claim 16, wherein the first angle is less than 20°.

20. The radially expandable artificial valve prosthesis of claim 16, wherein the first angle is less than 10°.

21. The radially expandable artificial valve prosthesis of claim 16, wherein the two longitudinal attachment struts extend generally parallel to one another from each of the commissural points.

22. A radially expandable artificial valve prosthesis for implantation in a vessel comprising:

5 a support structure having a first end that includes at least a first and a second commissure, and second end located distal thereto;

10 a plurality of leaflets, each having an outer edge that includes a first lateral edge extending distally from the first commissure and a second edge portion extending distally from the second commissure, the first and second lateral edges generally converging about the second end such that the plurality of leaflets collectively form a seal with the walls of the vessel and cooperate with one another to restrict fluid flow therethrough; and

15 wherein the first and second lateral edges are each attached to the support structure along an attachment pathway that includes a first, proximal portion comprising a substantial portion of the length of the prosthesis having primarily a longitudinal orientation with respect to the longitudinal axis of the prosthesis, and a second, distal portion angling obliquely from the first portion such that plurality of leaflets each comprise

20 an extensive coaptable portion that defines the side of a large pocket located adjacent to each leaflet, and a basal portion that defines the bottom of the pocket when the prosthesis is implanted within the vessel.

23. A radially expandable artificial valve prosthesis for implantation in a vessel comprising:

25 a support structure having a first end that includes a first and a second commissure, and second end located distal thereto;

 a pair of leaflets, each having an outer edge that includes a first lateral edge extending distally from the first commissure and a second

edge portion extending distally from the second commissure, the first and second lateral edges generally converging about the second end such that the plurality of leaflets collectively form a seal with the walls of the vessel and cooperate with one another to restrict fluid flow therethrough; and

5 wherein the first and second lateral edges are each attached about a first strut that extends from the first and second commissure structure along an attachment pathway that includes a first, proximal portion comprising a substantial portion of the length of the prosthesis having primarily a longitudinal orientation with respect to the longitudinal 10 axis of the prosthesis, and a second, distal portion angling obliquely from the first portion such that plurality of leaflets each comprise an extensive coaptation portion that defines the side of a large pocket located adjacent to each leaflet, and a basal portion that defines the bottom of the pocket when the prosthesis is implanted within the vessel.

15 24. A radially expandable artificial valve prosthesis for deployment in a bodily passage, comprising:

 a valve structure, including a plurality of leaflets adapted to restrict fluid flow therethrough, each of the plurality of leaflets comprising a free inner edge and an outer edge that includes a first and second lateral 20 outer edge which interconnect distally to form a bottom edge;

 a support structure comprising a series of proximal bends comprising commissural points for the attachment of the plurality of leaflets; and longitudinal attachment struts extending distally therefrom, the support structure further comprising a pair of distal attachment struts 25 extending distally and circumferentially from the longitudinal attachment struts; and

 wherein the lateral outer edges are attached proximally along the longitudinal attachment struts to form an extensive leaflet contact area, and distally along the distal attachment struts which converge laterally and carry

the bottom edge of each of the plurality of leaflets such that the prosthesis is adapted for forming a seal between the plurality of leaflets and the walls of the bodily passage and creating a large pocket at the base of each of the plurality of leaflets that is of sufficient size and shape such that fluid flowing

5 in the retrograde direction is capable of achieving flow patterns that reduce stagnation of fluid therein.

25. The radially expandable artificial valve prosthesis of claim 24, wherein the longitudinal attachment struts are sized to create a leaflet contact area that comprises 10-80% of the length of the valve structure.

10 26. The radially expandable artificial valve prosthesis of claim 24, wherein the longitudinal attachment struts are sized to create a leaflet contact area that comprises 30-60% of the length of the valve structure.

15 27. The radially expandable artificial valve prosthesis of claim 24, wherein the longitudinal attachment struts are sized to create a leaflet contact area that comprises 35-55% of the length of the valve structure.

28. A radially expandable artificial valve prosthesis for deployment in a bodily passage, comprising:
a pair of opposing leaflets configured to cooperate with one another to restrict fluid flowing therethrough, each of the opposing leaflets having proximal portion a distal portion, an inner edge traversing the lumen of the bodily passage and an outer edge comprising a first and second lateral outer edge;
wherein the outer edges of the opposing leaflets include an attachment pathway coextending therealong, wherein the attachment pathway comprises an attachment with at least one of a support frame and the inner walls of the bodily passage such that the attachment pathway

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defines the shape and configuration of the plurality of leaflets when the prosthesis is implanted in the bodily passage, and

wherein attachment pathway comprises extends along the first and the second lateral outer edge of each leaflet, each of the first a second

5 lateral outer edges including a proximal attachment pathway portion having a substantially longitudinal orientation with respect to the prosthesis such that a large leaflet contact area is established between the opposing leaflets, and distal attachment pathway portion which converges with that of the other of the first and second lateral outer edge to define a

10 bottom edge of the leaflet such that the bottom portion of the leaflet angles extend laterally from the substantially longitudinally aligned proximal portion in a manner that forms a seal and creates a wide pocket about the junction of the proximal and distal portions that is adapted for creating retrograde flow patterns sufficient to reduce stagnation of fluids therein.

15 29. A radially expandable artificial valve prosthesis for deployment in a bodily passage, comprising:

20 a first leaflet having a first and second lateral outer edges and a first leaflet surface;

25 a second leaflet having a first and second lateral outer edges and a second leaflet surface;

an expandable support structure defining means for positioning the first and second leaflet surfaces substantially opposite one another and substantially along a longitudinal axis of the support structure for a majority of the lengths thereof; and

25 wherein the first and second lateral outer edges of each of the first and second leaflets are attached along the support frame.